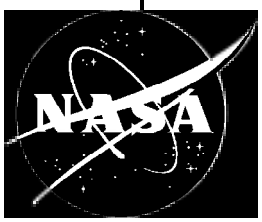
540-097

MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE

Interface Control Document (ICD) Between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and the Landsat Processing System (LPS)

September 1997



National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

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September 1997

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Greenbelt, Maryland

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Preface

This document is under the configuration management of the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division Configuration Control Board (CCB).

Proposed changes to this document shall be submitted to the Nascom CCB, along with supportive material justifying the change. Changes to this document shall be made by Document Change Notice (DCN) or by complete revision.

Questions concerning this document and proposed changes shall be addressed to:

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Abstract

This Interface Control Document (ICD) describes interface agreements between the Landsat Processing System (LPS) and the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet).

Keywords: *EBnet, ICD, interface control document, Landsat Processing System, LPS*

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Section 1. Introduction

1.1 Authority and Responsibility

The Mission Operations and Data Systems Directorate (MO&DSD) has the authority to implement the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet). This authority was granted to MO&DSD by the EOS project under the Office of Mission to Planet Earth (Code Y). The EBnet project is under the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division of the MO&DSD.

Code 540 will provide an operational communications network to support high-speed network communications between EBnet and non-EBnet hosts. The primary responsibility for this project has been assigned to the Nascom Division, Code 540. The system requirements are documented by the references in Section 2.1.

1.2 Purpose

The purpose of this document is to provide a detailed definition of the interface(s) between the EBnet and the Landsat Processing System (LPS).

1.3 Scope

This document defines and specifies the data transport interfaces (i.e., protocols, standards applied, physical connections, and locations connected) between EBnet and the LPS.

1.4 Time Frame

This Interface Control Document (ICD) shall be in effect from the date of approval by the Nascom CCB and the Chief of the Nascom Division, and when all applicable signatures are obtained.

1.5 Goals and Objectives

The goals of EBnet are to:

a. Implement an operational, integrated, transparent communications system that serves the data communications needs of projects supported by NASA Goddard Space Flight Center (GSFC), and users outside the MO&DSD.

b. Expand using industry standard system solutions while maintaining compatibility with the existing network and user interfaces.

c. Minimize costs for implementation, operation, and maintenance of the network.

d. Minimize life-cycle costs.

e. Maintain high availability by designing with redundancy, and without single points of failure in the Network Backbone, where required.

f. Utilize state-of-the-art technology, utilizing equipment with the best price-performance available commercially.

g. Allow for growth, adaptability to changing requirements, infusion of new technology, and upgraded interfaces throughout the life-cycle.

1.6 Standards Precedence

EBnet will be based on Government, commercial, and international standards. In case of conflict, the following precedence (in descending order) applies:

- This EBnet ICD.
- Government standards.
- Commercial and/or international standards.

1.7 Document Organization

Section 2 contains parent, applicable, and reference documents related to this ICD.

Section 3 details a systems overview of EBnet.

Section 4 presents an interface detailed design.

Section 5 describes the facilities and maintenance demarcation.

A list of abbreviations and acronyms is provided at the end of the document.

Section 2. Related Documentation

2.1 Parent Documents

[1] *Earth Observing System AM-1 Detailed Mission Requirements*, Goddard Space Flight Center (GSFC), 505-10-33, November 1996

[2] *Earth Science Data Information System (ESDIS) Project Level 2 Requirements Volume 6, EOSDIS Backbone Network (EBnet) Requirements*, Goddard Space Flight Center (GSFC) 505-10-01-6, Revision A, December 1996

[3] *Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Interface Requirements Document (IRD)*, September 1997

[4] Reserved

2.2 Applicable Documents

[5] *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*, Electronic Industries Association (EIA) 422-A, December 1978

[6] *General-Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, EIA 449, November 1977

[7] *Internet Protocol (IP): DARPA Internet Program Protocol Specification*, Request for Comment (RFC) 791, September 1981

[8] *The Point-to-Point Protocol (PPP)*, RFC 1661, July 1995

[9] *An Ethernet Address Resolution Protocol or Converting Network Protocol Addresses to 48-bit Ethernet Addresses for Transmission on Ethernet Hardware*, RFC 826, November 1982

[10] *Internet Control Message Protocol*, RFC 792, September 1981

[11] *Routing Information Protocol (RIP)*, RFC 1058

[12] *Open Shortest Path First (OSPF)*, RFC 1247

[13] *Internet Group Multicast Protocol (IGMP)*, RFC 1112

[14] *On the Assignment of Subnet Numbers*, RFC 1219

[15] *Simple Network Management Protocol (SNMP)*, RFC 1157

[16] *Address Resolution Protocol (ARP)*, RFC 826

[17] *A Reverse Address Resolution Protocol (RARP)*, RFC 903

[18] *Internet Protocol on Ethernet Networks*, RFC 894

[19] *Transmission of IP over FDDI*, RFC 1188

[20] *Structure of Management Information*, RFC 1155

[21] *Management Information Base - II*, RFC 1213

[22] *Transmission Control Protocol*, RFC 793

[23] *Telnet Protocol*, RFCs 854 & 855

[24] *File Transfer Protocol*, RFC 959

[25] International Organization for Standardization (ISO) 9314-1, *FDDI Physical Layer Protocol (PHY)*

[26] ISO 9314-2, *FDDI Media Access Control (MAC) Protocol*

[27] ISO 9314-3, *FDDI Physical Layer Medium Dependent (PMD)*

[28] ISO 8802-2, *Logical Link Control (LLC)*

[29] ISO 8802-3, *Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) Media Access Control (MAC) - Ethernet version 2*

[30] Institute of Electrical and Electronic Engineers (IEEE) 802.3 *10Base-T (twisted pair)*

[31] IEEE *10Base5 (thick ethernet)*

[32] International Telegraph and Telephone Consultative Committee (CCITT) *V.35*

2.3 Reference Documents

[33] *NASA Communications (Nascom) Access Protection Policy and Guidelines*, 541-107, Revision 3, GSFC, November 1995

[34] *NASA Communications System Acquisition and Management*, NASA Management Instruction (NMI) 2520.1D, National Aeronautics and Space Administration (NASA), November 18, 1991

[35] *Nascom IONET Users Guide*, 541-225, Revision 1, April 1996

Section 3. Systems Overview

3.1 EBnet General System Description

The EBnet provides wide-area communications circuits and facilities between and among various EOS Ground System (EGS) elements to support mission operations and to transport mission data between EOSDIS elements. The relationship of EBnet to other elements supporting EOS is shown in Figure 3-1. EBnet is responsible for transporting spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week. The EBnet capability to transport those two diverse types of data is implemented as two distinct subnetworks referred to as "real-time" and "science" networks. The real-time network transports mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry as well as prelaunch testing and launch support. This highly redundant network provides an operational availability of 0.9998 with a Mean Time to Restore Service (MTTRS) of 1 minute. The science network transports data collected from spacecraft instruments and various levels of processed science data including expedited data sets, production data sets, and rate-buffered science data. The science network provides an operational availability of 0.98 with a MTTRS of 4 hours.

EBnet provides three options for accessing the Internet Protocol (IP)-based EBnet transport service: Local Area Network (LAN) Ethernet, LAN Fiber Distributed Data Interface (FDDI), and Wide Area Network (WAN) carrier service. Figure 3-2 shows an example of each of these types of interface/demarcation points to EBnet users. This ICD describes the EBnet/LPS interface which uses the WAN and/or LAN interface types.

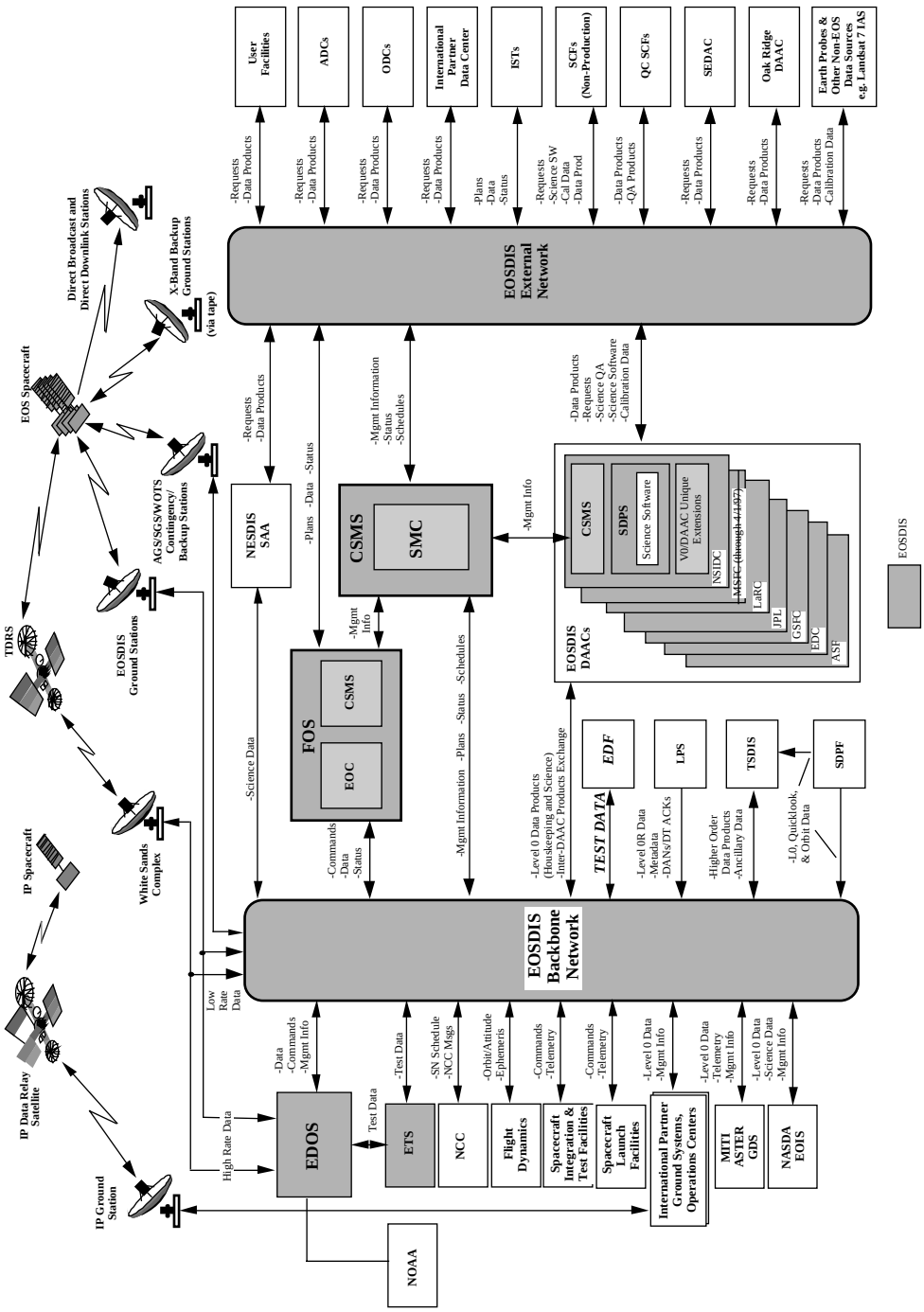


Figure 3-1. EOS Ground System

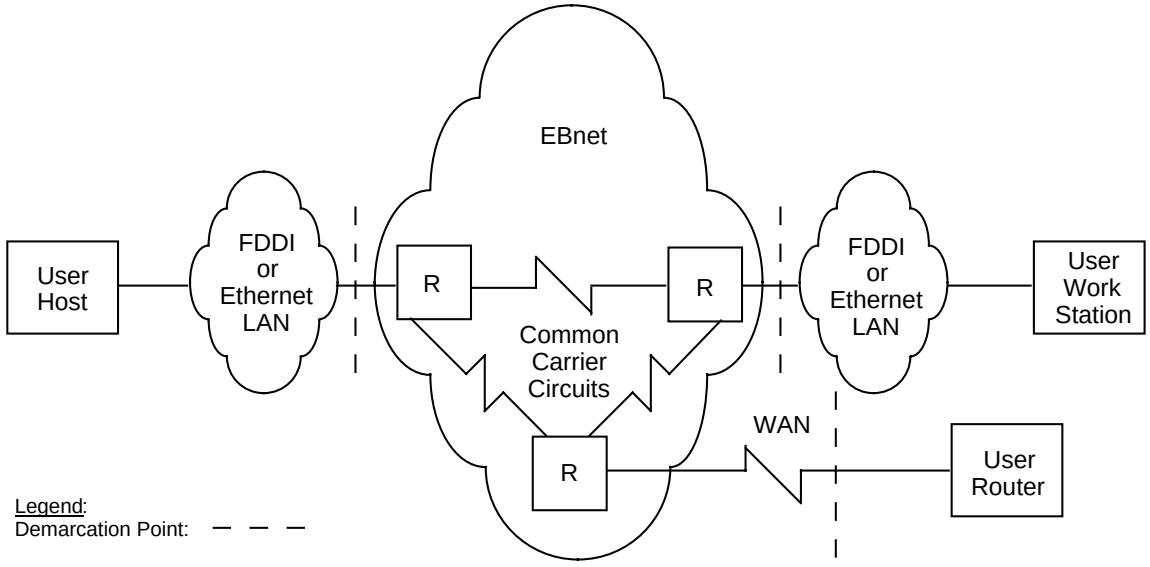


Figure 3-2. EBnet Demarcations

Sustaining engineering, preventive and remedial maintenance, and network monitoring services are provided for EBnet equipment, to ensure that EBnet keeps pace with technology and standards, and provides continuous service. The official point of contact for EBnet operational status is the Nascom Communications Manager (COMMGR) (301-286-6141). Users who detect a network problem are urged to immediately report it to the COMMGR. The COMMGR may also provide users with limited information about maintenance and status actions. Refer to the Nascom IP Operational Network (IONET) User Guide (541-225) for information regarding user connections, security guidelines, and maintenance information.

3.2 LPS Description

LPS is a major component of the Landsat 7 system. It is located along with the Landsat Ground Station (LGS) and the EROS Data Center (EDC) Distributed Active Archive Center (DAAC), at the EROS Data Center (EDC), Sioux Falls, South Dakota.

The LPS receives Enhanced Thematic Mapper Plus (ETM+) wideband data, acquired by the LGS, directly from the Landsat 7 spacecraft, via four 75 megabits per second (Mbps) channels. The LPS coordinates its operations with the LGS in accordance with the Landsat 7 contact schedule, provided by the Mission Operations Center (MOC) to the LGS and the LPS. The LPS receives and records the return link wideband data, in real-time, from the four output channels of the LGS connected to four LPS strings. Within 16 hours of the data acquisition from the LGS, the LPS processes the raw wideband data to Level 0R, saves it to Digital Linear Tape (DLT), and makes it available for transfer to the EDC DAAC. The LPS can process 275 ETM+ scenes per day (250 scenes received from the LGS plus 25 stored scenes for which the Image Assessment System (IAS) has

requested reprocessing) and sustains this rate as long as the Bit Error Rate (BER) is no worse than 1 error in 10**5 bits.

The LPS generates and saves quality and accounting for all of its Level 0R processing. This information is part of the metadata transmitted to the EDC DAAC and is also the basis of quality and accounting reports generated for review by LPS operations personnel during Level 0R processing. The LPS provides regular reports of the number of errors encountered and can also provide a low-resolution moving window display of the output data as it is processed. These capabilities allow LPS operators to monitor quality during processing.

LPS consists of a total of five logically independent processing strings. Four strings are used to support normal operations while the fifth string serves as a back-up string and facilitates system testing, software development, and training. Figure 3-3 illustrates the LPS interconnect architecture.

3.3 Relationship Between LPS and EBnet

The interface between the LPS and EBnet is to support the transmission of Landsat 7 Level 0R data from the LPS to the EDC DAAC. The data flows out of the LPS supported by EBnet are considered to be science traffic. (For the purpose of EBnet ICDs, any traffic type that is not real time is considered to be science traffic.) Both the LPS and the EDC DAAC are located at the EDC facility.

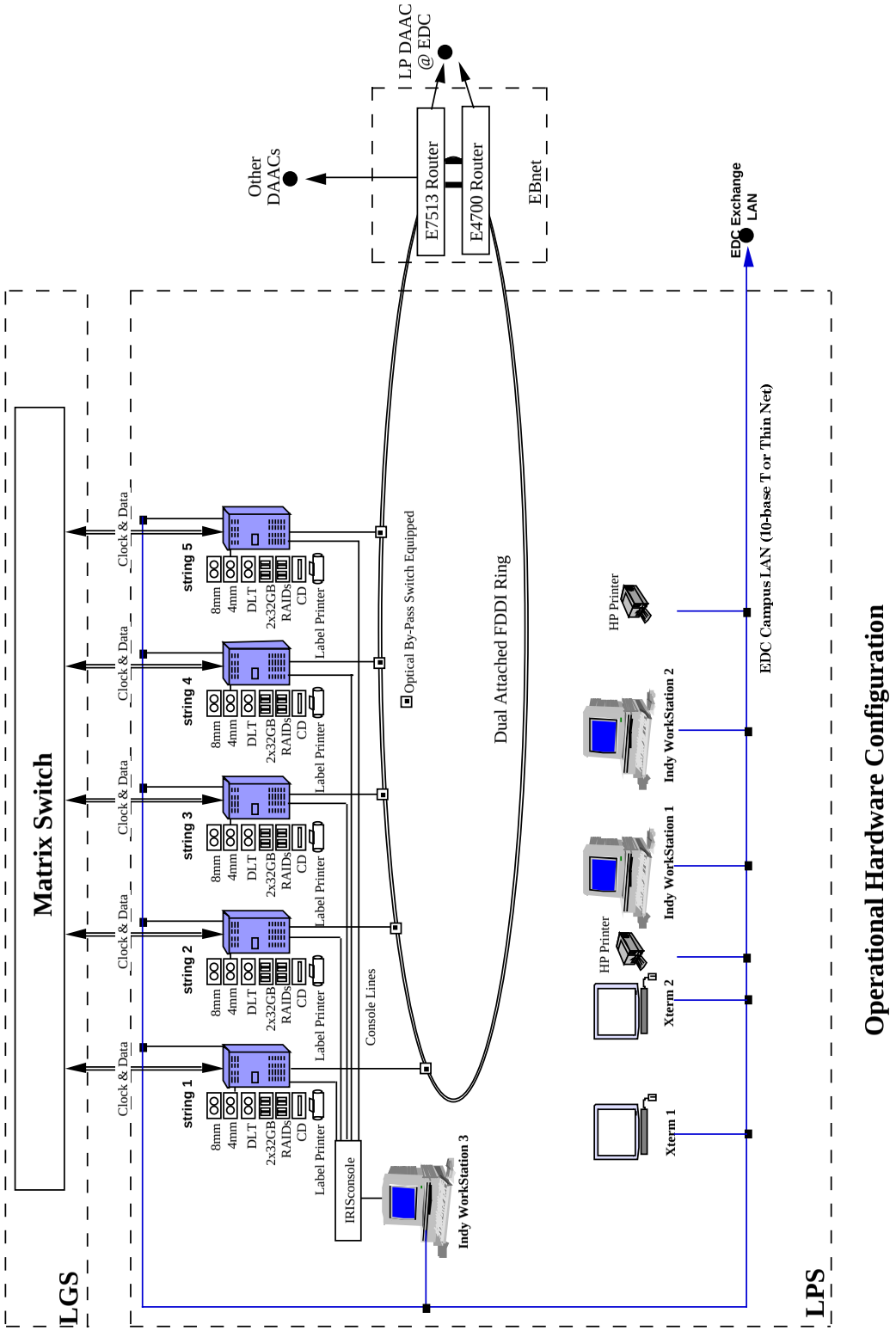


Figure 3-3. LPS Interconnect Architecture

Section 4. Interface Detailed Design

4.1 Interface Design Overview

The EBnet and LPS interface design, as shown in Figure 4-1, consists of a FDDI interface with connections extending to LPS components. Two EBnet routers will provide connectivity between the LPS, the DAAC at EDC, and WAN connectivity.

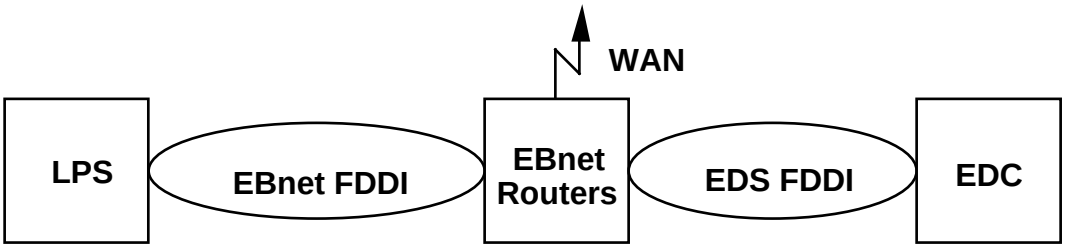


Figure 4-1. LPS Interface

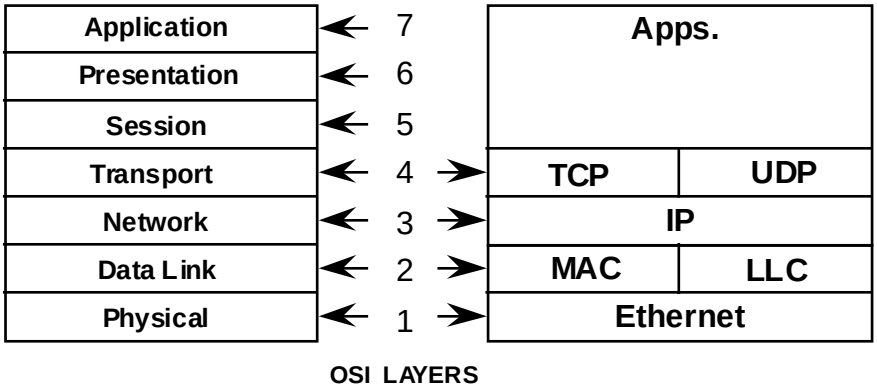
The detailed design of the LPS-EBnet interface is shown in Figure 4-2. Two Cisco routers will be used for the LPS interface to the EBnet WAN and the LP DAAC. For purposes of the LPS interface, one router is designated as primary and the other router is designated as secondary. The primary router provides the nominal data path between the LPS and the EDC DAAC. The secondary router provides a backup path should the nominal path ever fail. This approach was dictated by a 15 minute mean time to restore requirement which is unique to the LPS to EDC DAAC interface. The primary router is a Cisco 7500 series with three FDDI interfaces and one High-Speed Serial Interface (HSSI) interface. The secondary router is a Cisco 4700 series with two FDDI interfaces. All of the EBnet FDDI connections are dual attached. The Cisco 4700 router is dual attached to the Cisco 7500 router to complete a single-failure, fault-redundant data path.

4.2 Design Assumptions

The LAN segment has FDDI throughput capabilities. A FDDI interface was chosen with the consideration of LPS requirement to transact 140 gigabytes of data in a 24-hour time period.

4.3 Data Interface Design

The data interface design provides communication between the LPS and the EDC DAAC. EBnet provides two routers. These routers provide protocol-based routing and filtering. Both routers support physically and functionally identical interfaces to the LPS.


Application
Presentation
Session
Transport
Network
Data Link
Physical
7
6
5
4
3
2
1
Apps.
TCP
UDP
IP
MAC
LLC
Ethernet

OSI LAYERS

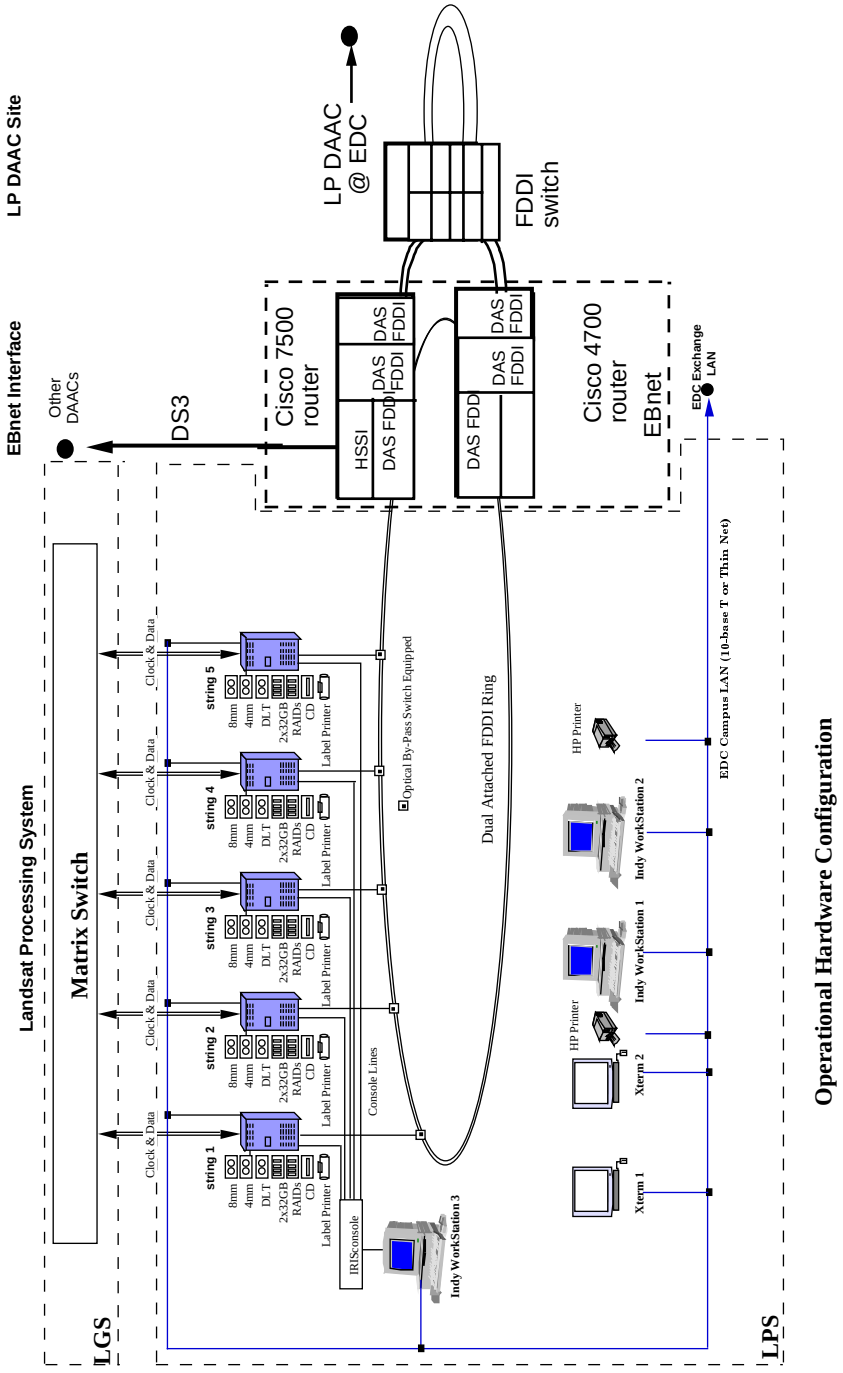


Figure 4-2. LPS-EBnet Interface

4.3.1 Physical Layer

EBnet will support the following physical layer connections:

a. IEEE 802.3, 10 Base-T (unshielded twisted pair) with RJ-45 connectors.

b. ISO 9314-1, FDDI Physical Layer Protocol.

4.3.2 Data Link Layer Protocol

EBnet will support the following data link interfaces:

a. ISO 802.2, Logical Link Control (LLC).

b. ISO 8802-3, Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) Media Access Control (MAC) - Ethernet Version 2.0 is supported.

c. ISO 9314-2, FDDI MAC Protocol.

4.3.3 Network Layer Protocol

EBnet will support the following network layer protocols:

a. RFC 791, Internet Protocol Version 4.0.

b. RFC 826, Address Resolution Protocol (ARP).

c. RFC 792, Internet Control Message Protocol (ICMP).

d. RFC 1112, Internet Group Multicast Protocol (IGMP).

4.3.4 Transport Layer Protocol

EBnet will support transparent communication at the transport layer.

4.3.5 Session Layer

EBnet will support transparent communication at the session layer.

4.3.6 Presentation Layer

EBnet will support transparent communication at the presentation layer.

4.3.7 Application Layer

EBnet will support transparent communication at the application layer.

4.4 Routing and Addressing Guidelines

EBnet will be internetworked by routers and switches which will be configured to support only the IP, and will provide isolation for separate networks. Cisco 7513 and 4700 routers have been chosen to provide network access to the LPS.

EBnet will utilize standard IP addressing conventions. EBnet will provide a Class C subnet address if requested by the user. The address assigned to LPS is 198.118.204.96 subnet mask 255.255.255.224.

4.5 Performance

EBnet envisions that the data flow requirements for this ICD is well within the performance guidelines for the equipment that it expects to deploy for this circuit.

4.6 Data Flow Requirements

The data flow requirements for this circuit are within the design criteria for the equipment involved in the design of this circuit.

4.7 Equipment List

EBnet will provide the following equipment to support this interface:

a. T3 Multiplexer: DigitalLink (Model DL3100).

b. Primary Router: Cisco (Model 7513).

c. Secondary Router: Cisco (Model 4700).

Section 5. Facilities and Maintenance Demarcation

5.1 Equipment Location

The LPS will be located in the Mundt Federal Building, Room 1500 at the EDC.

5.2 Maintenance Demarcation

The demarcation point between EBnet maintenance and LPS maintenance is the connection at the EBnet routers. Cabling connecting to the EBnet routers from the LPS FDDI will be provided and maintained by the LPS.

Abbreviations and Acronyms

ARP	Address Resolution Protocol
BER	Bit Error Rate
BOOTP	is a protocol used by a network node to determine the IP address of its network interface to execute network boot.
CCB	Configuration Control Board
DCN	Document Change Notice
DLT	Digital Linear Tape
EBnet	EOSDIS Backbone Network
ECS	EOSDIS Core System
EDC	EROS Data Center
EGS	EOS Ground System
EIA	Electronic Industries Association
ETM+	Enhanced Thematic Mapper Plus
EOC	EOSDIS Operations Center
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
EROS	Earth Resources Observation System
ESDIS	Earth Science Data and Information System
FDDI	Fiber Distributed Data Interface
GSFC	Goddard Space Flight Center
HSSI	High-Speed Serial Interface
IAS	Image Assessment System
ICD	Interface Control Document
ICMP	Internet Control Message Protocol
IEEE	Institute of Electrical and Electronic Engineers
IGMP	Internet Group Multicast Protocol
IONET	IP Operational Network

IP	Internet Protocol
IRD	Interface Requirements Document
ISO	International Organization for Standardization
LAN	Local Area Network
LGS	Landsat Ground Station
LP	Landsat Processing
LPS	Landsat Processing System
MAC	Media Access Control
MO&DSD	Mission Operations and Data Systems Directorate
MOC	Mission Operations Center
MTTRS	Mean Time to Restore Service
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NMI	NASA Management Instruction
OSI	Open Systems Interconnection
OSPF	Open Shortest Path First
PHY	Physical Layer Protocol
PMD	Physical Layer Medium Dependent
RARP	Reverse Address Resolution Protocol
RFC	Request for Comment
WAN	Wide Area Network